Geophysical Research Abstracts
Vol. 14, EGU2012-4201, 2012
EGU General Assembly 2012

Reflection seismic survey across a fault zone in the Leinetal Graben, Germany, using P- and SH-waves

P. Musmann, U. Polom, H. Buness, and R. Thomas

Leibniz Institute for Applied Geophysics, Seismics, Magnetics and Gravimetry, Hannover, Germany
(patrick.musmann@liag-hannover.de)

Fault systems are considered as a valuable hydro-geothermal reservoir for heat and energy extraction, as permeability may be enhanced compared to the surrounding host rock. Seismic measurements are a well established tool to reveal their structure at depth. Apart from structural parameters like dip, extent and throw, they allow us to derive lithologic parameters, e.g. seismic velocities and impedance. Usually, only compressional waves have been used so far.
In the context of the "gebo" Collaborative Research Program, seismic methods are revised to image and characterize geological fault zones in order to minimize the geological and technical risk for geothermal projects. In doing so, we evaluate and develop seismic acquisition, processing and interpretation techniques both for compressional and shear wave surveys to estimate the geothermal potential of fault zones.
Here, we present results from high-resolution P- and SH-wave reflection seismic surveys along one and the same profile. They were carried out across the eastern border of the Leinetal Graben, Lower Saxony, Germany. At this survey site, primarily Triassic units crop out that are disrupted by major fault system probably extending down into Permian Zechstein.
The seismic P-wave measurements (2.5 m CDP spacing, 20 – 180 Hz sweep sent out by a small vibrator) imaged the structure of the subsurface and its fault inventory with high resolution. Imaging ranges from approximately 50 m (base Keuper) to approximately 1.8 km (within Zechstein) depth. The profiles reveal that the area has undergone multiphase tectonics. This becomes manifest in a complex seismic reflection pattern. In addition the P-wave velocity model shows several features that can be related to folding and faulting.
Preliminary results of the SH-wave measurements (0.5 m CDP spacing, 10 – 100 Hz sweep) show that the complex structural geological settings in the subsurface, as imaged by the P-wave survey, can also be imaged by a reflection shear-waves survey. Imaging starts at a few meters below surface but only extents down to approximately 500 m depth. Compared to the P-wave survey, resolution in the near-surface domain is significantly higher, but seems to decrease more rapidly with increasing depth. Further, due to the shorter wavelength, S-wave reflection events are more affected by inhomogeneities in the subsurface resulting in less continuity of reflection events.
In the ongoing project P- and SH-measurements will be compared with respect to their structural image, resolution and velocity distribution. The overall aim is to derive elastic parameters, i.e. shear and bulk moduli.